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Application of Wearable Fitness Monitors in mHealth
A Competitive Approach for Naturkompaniet AB

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The focus of this research work is on exploring the applicability of wearable Fitness tracking technologies in Healthcare. The general aim of this research is to stress the relevance and value of wearable technologies for the delivery of an increasingly flexible healthcare system, the economic importance and privacy concerns. The specific objective of this research is to explore the uses and benefits of wearable technologies in electronic and mobile healthcare for the improvement of access, quality, efficiency in healthcare delivery and the economic potentials with a view to promote its use in a global scale. Accordingly, the research recommends the adoption of fitness tracking devices to the product-line of Naturkompaniet AB, which is a retail store that specializes in outdoor and sporting wares.

The concept of health and fitness tracking despite being a relatively recent phenomenon has been studied to an extent. However, its ubiquitous integration into healthcare delivery is still a novel idea. This research is borne out of the need to help acquire a more comprehensive understanding of health and fitness tracking. To attain the objectives of this research, the technologies of wearable technologies are examined. The concept of health and fitness tracking are studied and described. Additionally, its benefits in delivering enhanced healthcare and economic potentials are indicated and examined.

The exploratory research method was used in this research based on the research questions and the desired objectives. This research employs the use of primary data from the case company and mostly secondary data sourced from books, scientific and academic journals mainly in electronic format. In order to bolster the credibility of this research work, the interview research method was also employed using the case company to constitute the practical implementation of the work.

The outcome of this research is an adequate recommendation for fitness tracking devices adoption model for Naturkompaniet AB. The recommendation emphasizes the need to add fitness tracking wearable devices to their range in order to provide increased options to their clients and to give a competitive edge to the organization.

Key words IoT, Wearables, mHealth, wearable fitness monitors

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1 INTRODUCTION

The background of the thesis is discussed in this chapter and the relevance of the topic is motivated. Furthermore, the objectives of the research work are detailed together with the structure of this thesis work in the chapter.

1.1 Background and Motivation

There has been notable interest shown by researchers in the significance of Information technology (Hereinafter IT) solutions for Organizations. Studies have been conducted with focus on examining the technical spheres involved with the development and implementation of technology-based service tools (Wang & Cheng & Huang 2013.) These studies, coupled with the huge progress in the electronic sector, the availability of wireless communications and the rapid spread of mobile technology within the last decade has created a scenario where the usefulness of devices is no longer limited to merely connecting users to the Internet. However, mobile technology is also able to bridge the physical and the cyber world, by making use of the Cyber Physical Systems. (Hereinafter CPS) (Borgia 2014, 3.)

There is no denial that in their daily lives, individuals are increasingly dependent on one form of mobile technology or another. The increased usage of mobile technology also coincides with the era where devices are shrinking in size and are able to communicate across various platforms. The ability for these devices to interact is based on the concept of machine to machine (Hereinafter M2M) communication. This ability, coupled with the increasingly popular Internet of Things (Hereinafter IoT) concept has ushered in the possibility for devices to communicate freely without human involvement (Al-Karaki & Chen & Morabito & De Oliveira 2014, 1). Figure 1 below makes a depiction of the IoT lifecycle and the emerging technologies including a few wearable devices often referred to as wearables and similar to the ones in use today.

Figure 1. The Emerging IoT Scene (Borgia 2014, 2)

The Figure above shows the scenario that is rapidly emerging in the IT field. The human is totally immersed in a technology environment that consists of mobile devices with which they can connect to cloud related services. The mobile devices have the capability to communicate with IoT devices using the internet and cloud computing platforms. As a result, the human is surrounded by a so-called “sensory swarm” that consists of smart devices. (Borgia 2014, 2.)

The concept of wearable Technology and IoT are inseparable, with the former being an offshoot of the broader concept of IoT. Hence, a decent understand of the IoT concept is required. The term of IoT was invented by Kevin Ashton, a founding member of the original Auto-ID Centre at the Massachusetts Institute of Technology (MIT) in 1999 (Borgia 2014, 3). Figure 2 below is a compact view of the various IoT terminologies as designed by Zhou (2013, 13).

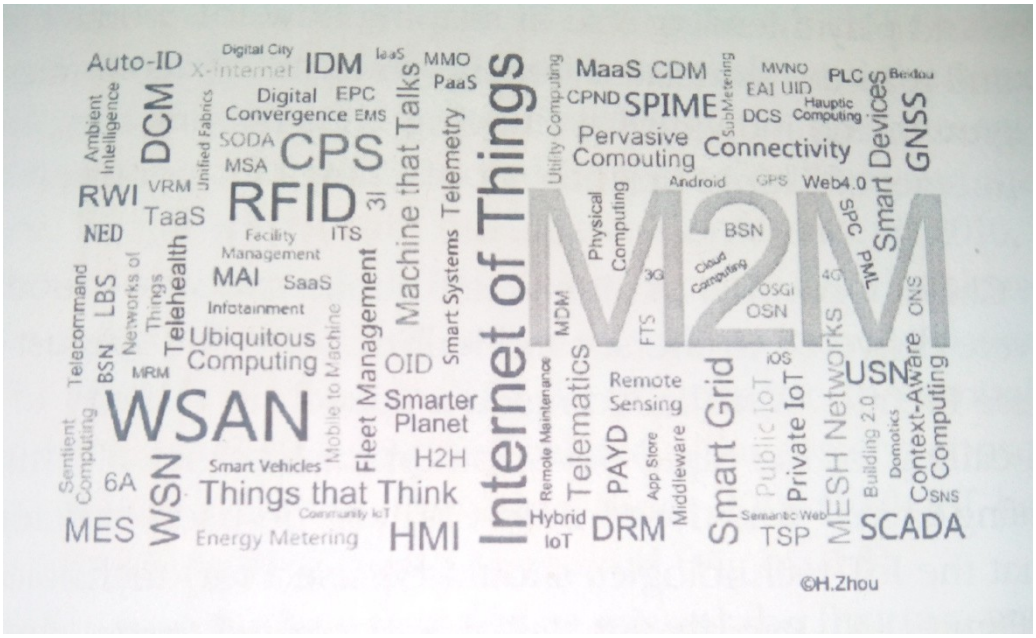


Figure 2. IoT-Related Terms (Zhou 2013, 13)

The variety and diversity of the terminologies in Figure 2 is an indication of how broad the concept of IoT is. Therefore, there is a need to be more specific with the choice of topic and research scope. Terminologies like the Radio Frequency Identification (Hereinafter RFID) and Supervisory Control and Data Acquisition (Hereinafter SCADA) will be discussed in subsequent sections.

Wearable Technology is a concept that fall within the scope of the IoT. According to Tehrani and Mitchell (2014.), Wearable Technologies or devices are electronic devices that could be integrated into accessories and clothing items to be comfortably worn on the body. These devices have the ability to perform many of the computing tasks that mobile phones and portable personal computers can but could in some cases outperform them completely due to some additionally sophisticated features such as biofeedback and physiological tracking. Wearables generally possess some communication abilities which allow real time access. Prior to commercialization, it was applied in military technologies and mainly in healthcare and medicine.

The prices of computer hardware keep getting cheaper. This has resulted in continuous development of cost-effective wearables for healthcare provisioning basically for the

monitoring of an individual's physiological processes (Ogunduyile, Olugbara & Lall 2013, 163). A new trend stands out as an exemplification of a wider reaching trajectory in healthcare service provisioning and one that creates an avenue for improved consumer participation and a decentralization of the healthcare system. This monitoring is typically achieved with the use of various wearables, i.e. embedded applications that synchronizes with other devices such as smart phones and allows the possibility for 'point-of-care' testing (Carrera & Dalton 2013, 37-38 original emphasis.)

The Healthcare consumers will be able to access their health related information with ease. This is a sharp deviation from the conventional scenario where medical information mostly rested in the hands of the professionals but even from an historical stand point, information has always been critical to the improvement of public healthcare and patient wellness. Carrera and Dalton (2013, 38) describe this development as a democratization of access to healthcare information, where healthcare consumers have access to an unlimited pool of information which would allow them to personally analyse health related patterns giving rise to self management when applicable and in essence bringing about the term 'do-it-yourself-healthcare'.

The choice for this research is borne out of the need for additionally effective integration of wearable technologies in healthcare. As suggested by Farmanfarmaian (2014), wearables have the potential to dramatically alter the sharing of information between doctors and patients and the decision making process as it concerns the patient's health. Farmanfarmaian (2014) went further to stress that such a transformation that allows patients' added involvement could amount to less doctor visits, decreased irrelevant medical tests, increase in the rate of successful treatments. Additionally, patients' involvement would also make healthcare more accessible and reduce the constraints of distance. Traditionally, these issues have constituted substantial challenges to the delivery of healthcare. According to Carrera and Dalton (2013, 38), many of the available devices are for example relevant for the effective self-monitoring of blood pressure for Hypertensive patients and the control of glucose in Diabetic patients. Figure 3 below shows the preferred choice of activity tracking applications among respondents.

Figure 3. Wearable User Interest (Statista 2014a)

The smartwatch is increasing in popularity and it is also able to deliver as a health monitoring device. Therefore, it is no surprise that there is a huge sales potential for wearables and this is buttressed by GFK (2014, 2) in its international research conducted in the five major markets for wearable devices. The major sales potential lies in the health and fitness monitoring based on the contribution of about 1,000 respondents from each country. The Figure shows that respondents were much more interested in health related applications. These data are an obvious indication of the economic potential that is available in wearables for Healthcare and fitness monitoring that needs to be further explored.

1.2 Structure of the Thesis

This Thesis work is divided into six chapters. Chapter 2 defines the scope and objective of this research, the research questions, research methodology and Limitations. Chapter 3 presents the concept of IoT, wearable technology and the key technologies, with focus

on its application in healthcare. Chapter 4 offers an insight into the concept of Mobile Health (Hereinafter mHealth), Fitness Tracking, the available technologies, the economic impact of wearable fitness monitors while highlighting the privacy and security challenges associated with it. Chapter 5 makes suggestions for Naturkompaniet AB for the adoption of relevant wearables to their product and services lines. Chapter 6 discusses the results and draws conclusions on the work.

2 RESEARCH SCOPE, QUESTIONS METHODOLOGY AND LIMITATIONS

The objective and scope of this research work are discussed in the first sub-chapter. This discussion is followed by justifying the research questions that have been formulated to help achieve the objectives of this research. The methodology of this research and the limitations are also discussed.

2.1 Objective and Research Scope

The objective of this research is to study and promote the application of wearable technologies in the health sector based on the concept of patient inclusive decision making. This study also analyzes the economic importance of augmenting wearables into healthcare and the resultant benefits of swift health service provisioning. This analysis would be achieved by studying the fundamentals of wearable technology, the various technologies that support this concept and their modes of deployment.

Additionally, the understanding of the concepts of wearables is simplified. It was evident during the search for a case company that the understanding of wearable technology not least its application in health and fitness monitoring eludes many individuals and organizations alike. The Privacy and security concerns are also emphasized as a concern for the sensitivity of data that pertains to patients and individuals.

The practical outcome of this research is focused on making recommendations for Naturkompaniet AB for the adoption of wearables into their product line. The recommendations aim to highlight the benefits for both the wellbeing of the clients and the competitive advantage it offers to the organization.

This research has uses up to date and relevant literature. The scope of the research has been limited to the concepts of Wearable Technologies and Health and Fitness Monitoring with a view to encourage the further augmentation of both fields. This work does not attempt to make the decision for organizations to integrate wearables to their

line of product and there is no express assurance that the recommendations will work as suggested.

2.2 Research Questions

In order to achieve the objectives of this research work, the following research questions have been identified and addressed.

1. What are the concepts of IoT and Wearable Technology? What are the underlying technologies that drive their functionality?

   The concepts of IoT, wearables, and the supporting technologies are defined and discussed to answer these questions in chapters 3. The supporting technologies of wearables and mHealth tools are also examined in details.

2. How does the application of wearables in mHealth impact the quality of healthcare delivery and of what economic significance is it?

The concept of Mobile Health, applying wearable fitness monitors in healthcare and the benefits it would bring to improving the quality and flexibility of healthcare delivery from the perspective of both the organizations and individuals are discussed. Chapter 4 also focuses on discussing the economic potentials as far as cost saving and additional revenue is concerned.

3. How can Naturkompaniet AB utilize wearable devices to offer improved services to their clients and gain a competitive edge?

Investing in wearables presents a beneficial opportunity for any organization. This is specifically true in a region where an understanding of the concept of wearables is still relatively vague and not many organizations have made attempts to augment wearable services and products, Naturkompaniet AB – a company whose product line consists mainly of outdoor wears in the polar region, stands to benefit substantially from adopting this technology to its product line as wearables offer their customers additional comfort, flexibility and safety in addition to the competitive advantage that accompanies it.

2.3 Research Methodology

Integrating wearables into mainstream healthcare is not an entirely new development, even though it is still at an infancy stage. The research is primarily qualitative in nature and the concepts have been defined using this approach. The research work incorporates data from several sources whose data have been thoroughly analyzed and examined. The qualitative method was chosen because the theoretical aspect is derived from the analysis of a variety of literatures and some personal contribution.

The main method of this research is the exploratory research. Exploratory research is preferred because according to McDaniel Jr. and Gates (2010, 43), it serves the purpose of obtaining a better understanding of a concept or to solidify the definition of a problem. It is also utilized for the identification of key variables to be studied. The various concepts of wearable technologies, health and fitness monitors and mHealth will be explored and defined to make it more comprehensible especially to the less acquainted audience.

The interview research technique was utilized to justify the appropriateness of the research. In order to ensure that recommendation decisions are made with a detailed knowledge, semi-structured face-to-face interviews were conducted with two members of management from Naturkompaniet AB's Haaparanda, Sweden outlet. The members are the Store Manager who has been working there since inception in 2009 and a Sales Personnel who has been working for the company since 2010. The interviewees were chosen because the posses adequate knowledge about the organization and are in a good position to influence the decision making.

The outcome of the literature review and analysis constitute the theoretical aspect of this work while the interview interpretations constitute the practical aspect. The theoretical aspects involve an in-depth analysis of concepts and technologies of wearables and findings from this analysis are also utilized to make practical recommendations. The main limitation with this research work is with finding literatures that exclusively discusses wearables and their technologies. This is due perhaps, to the fact that a practical approaches have been made towards the concept rather than research.

Notwithstanding, the void has been filled with the use of some relevant literature from the broader concept of IoT.

3 ONTOLOGY OF WEARABLES AND IoT

This chapter presents an overview of wearable technology and the Internet of Things and the tools that support their functionality. The first section addresses IoT as the mother-concept of wearable technology, the application areas of IoT, the four pillars of IoT and the principal supporting technologies. Wearable technology is thoroughly explained in the second section, followed by the application scope of wearables and finally the Activity Monitoring Sensors which are of primary important to the functionality of wearables devices.

3.1 The Internet of Things

As stated earlier, it is practically impossible to discuss wearable technology without an adequate understanding of its mother concept of the Internet of Things often referred to as the Internet of Everything. Due to the ambiguous and all-encompassing nature of IoT, having a generally agreed definition is almost impossible because IoT relates to different people and fields of application in different ways (Zhou 2013, 18). The situation is buttressed by Weber and Weber (2010, 1), who simply describe IoT as an Internet-based information architecture that accelerates the interchange of goods and services. Evidently, the definitions for IoT have to be properly explained from different areas of application and point of view.

Some definitions are provided in this paragraph. Zhou (2013, 20, 21), defines IoT as a flood of technologies and their applications which presents an avenue for the access and guidance of all sorts of ubiquitous and distinctively identifiable devices, features and resources. These include devices which possess intrinsic intelligence such as transducers, sensors, actuators, motes and many other types of items with RFID tags. The immediate goal is to attain an extensive M2M connectivity and bold integration to provide fast, secure and personalised services and performance while the eventual goal is to construct a universally connected globe where productivity, energy efficiency, security and environmental friendliness is achievable.

A concise definition of IoT is offered by Borgia (2014, 1 original emphasis), as "an emerging paradigm consisting of a continuum of uniquely addressable *things* communication one with another to form a worldwide dynamic network". However, the description provided by Weber and Weber (2010, 1 original emphasis), that "The IoT has the purpose of providing an IT infrastructure facilitating the exchange of "things" in a secure and reliable manner, i.e. its function is to overcome the gap between objects in the physical world and their representation in information systems. The IoT might also serve as a backbone for ubiquitous computing, enabling smart environments to recognize and identify objects and retrieve information from the internet to facilitate their adaptive functionality". This description of IoT is detailed and focuses mainly on how it is applied in practice.

It is safe to ask why the IoT does not already exist as a common tool. Although, the internet, mobile devices and data service providers have been around for some time, IoT is still not a common technology tool. The answer to this question lies in the fact that humans have not been communicating enough with the tools that are available and within reach. Additionally, technologies such as barcodes, GPS, RFID and others belong to a "closed-loop" system that functions independently and are not yet functionally fused together (Weber & Weber 2010, 2, original emphasis.)

These definitions and descriptions explains the difficulty there is to reach a definite consensus or a generally accepted definition for the Internet of Things, though it could be defined or explained from different points of view depending on the particular scope of application or area of interest. However, the description provided by Weber and Weber (2010, 1 original emphasis), that "The IoT has the purpose of providing an IT-infrastructure facilitating the exchange of "things" in a secure and reliable manner" is of particular emphasis to this research.

3.1.1 IoT Application Domains

The Internet of Things possesses the capacity for the development of new intelligent applications in every domain or industry. This capacity owes mainly to the fact that it has the dual ability to exhibit both situated sensing; that is "allowing for instance to

collect information about natural phenomena, medical parameters or user habits" and to offer them customized services. Irrespective of the field of application, IoT applications strives to improve the quality of every-day living and will impact the economy and society at large significantly. Their coverage spans across various disciplines of human endeavour and can be categorized into three main domains namely; Industrial domains, Smart City domains and Health-Well being domain (Borgia 2014, 8.)

Borgia (2014, 8-11) identifies and explains these three IoT domains with examples and a diagrammatic representation. The following characterizes these domains:

1) In the Industrial Domain, IoT can be utilized in various industrial activities that involve commercial and financial proceedings between organizations and firms and other establishments. Typical examples includes "logistics, manufacturing, monitoring of processes, service sector, banking, financial government authorities and intermediaries"
2) In the Smart City Domain, IoT could be instrumental to the sustainability of the environment, cities and the quality of life of the populace. The priority is on energy and how to efficiently manage it.
3) While in the Health-Well being Domain, IoT will play a critical role in the development of intelligent services for aiding and enhancing societal activities. This development would make the decision making and administration of health related activities more inclusive of the populace (Borgia 2014, 8-11.)

Figure 4 below, adopted from Borgia (2014, 9) identifies these three IoT domains and the various scope of application.

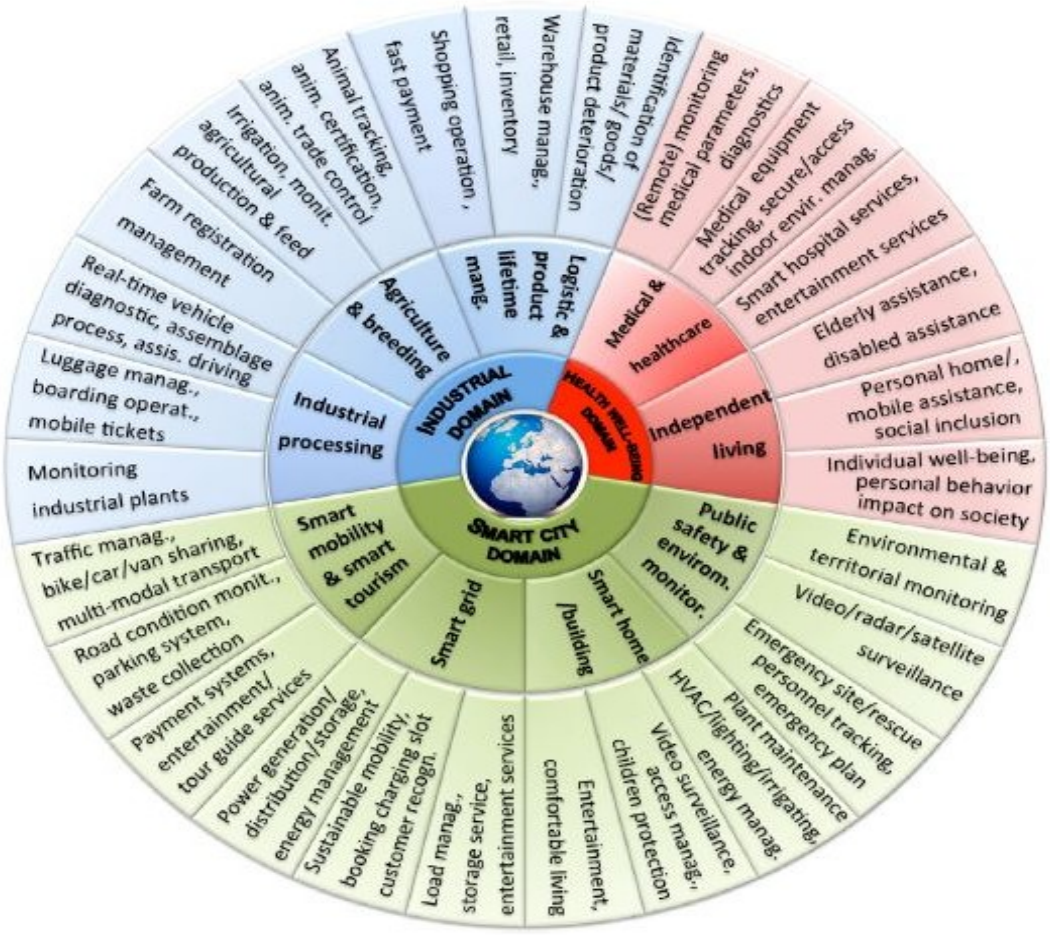


Figure 4. IoT Application Domains and Related Application (Borgia, 2014, 9)

Figure 4 is a representation of IoT Application Domains and the Related Applications. The figure presents a three level deep application process from the more general three domains to specific aspects of daily lives where the impact of the technology is felt and applied. It also defines the scope of these activities based on the scope of service delivery or product manufacturing in the specific industrial sector. The figure bridges the gap between the manufacturer's service delivery process and the end user's utilization of the products and services.

3.1.2 The Four Pillars of IoT Paradigm

Devices are becoming smarter in the nature of their design and functionality. IoT constitute a modern day example of a smart system whose ability to function is

dependent on the combination of less-complex components called Microsystems. Microsystems are small-sized mechanical, optical and fluid appliances while Smart Systems constitute a combination of the technologies of Microsystems with the expertise, technology and performance from fields of study like chemistry, biology, nano science and cognitive sciences (Zhou 2013, 64.) There are four Smart Systems that are essential for the technical functionality of the IoT and Zhou (2013, 63), refers to these smart systems as the "four pillars of IoT paradigm" namely; M2M, RFID, Wireless Sensor Networks (Hereinafter WSN), and Supervisory Control and Data Acquisition (SCADA). The four pillars are explained below:

1) M2M makes use of devices like in-vehicle gadget to capture happenings such as an engine malfunction using in most cases, wireless cellular network connections to a central server which then translates the captured events into comprehensible information.
2) RFID utilizes radio waves for the transfer of data from electronic tags fixed to an object to a centralized system via a reader with the aim of identifying and tracking the object.
3) A WSN is made up of spatially distributed autonomous sensors to keep track of physical conditions or state of the environment like temperature and to collectively transfer their data via the network ; mostly short-range wireless mesh networks.
4) SCADA is "an autonomous system based on closed-loop control theory or a smart system and it could also be described as a CPS that connects, monitors and controls equipment via the network (mostly wired short-range networks, a.k.a., field buses, sometimes wireless or hybrid) in a facility such as a plant or a building". SCADA is mostly applied in control centers to monitor the components of the power grid and also supply communications among these control centers and also the substations (Saputro & Akkaya & Uludag 2012, 2742 & 2750).

Figure 5 below presents the four pillars of IoT paradigm with examples showing the various disciplines where the smart systems could be applied.

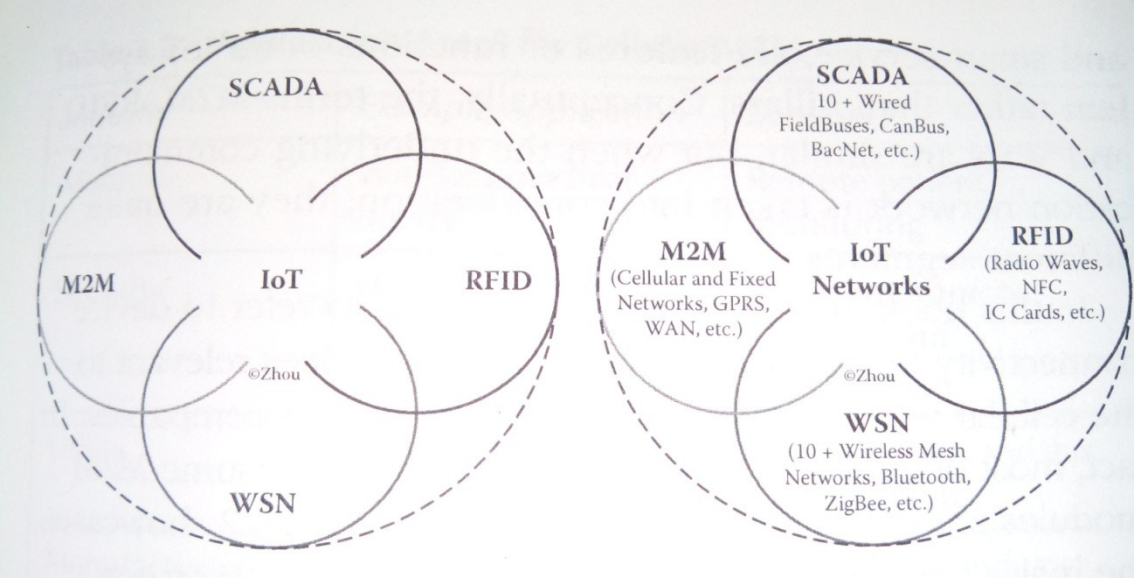


Figure 5. The Four Pillars of IoT Paradigms and Related Networks (Zhou 2013, 65)

Figure 5 presents IoT as the adhesive force that attaches the four pillars through a collective set of best practices, networking methodology and middleware platform. This system allows the user to connect every one of their physical assets with a joint infrastructure and a steady methodology for collecting machine data and interpreting its meaning. When the adhesive force is removed, the end users have to deal with having multiple application platforms and network accounts. Therefore, the real strength of the IoT lies in the activities that occur behind the scene while sharing a common platform for applications and this is impossible to achieve if organizations will have to manage multiple, independent systems. (Zhou 2013, 65.)

3.1.3 RFID

The RFID is at the core of IoT's communication infrastructure. From a technical perspective, the architecture of IoT is based on data communication tools and the Radio Frequency Identification (RFID) constitutes a very important data communication tool. It is a technology device used to track, locate and identify objects. Although the technique behind it has been understood and applied since at least the Second World

War era, it is still being utilized mainly in recent fields of civil application. This technology is steadily replacing the bar-codes because it does not require contacts with any other objects. As the quantity of produced tags remains on the increase, the prices are also expected to decrease (Weber & Weber 2010, 2.)

RFID could be described as a technology for identifying objects automatically with the use of wireless radio waves. Generally, it consists of two main components: a transponder also called RFID tag or chip which is affixed to the object to serve the purpose of a data carrier and a registration device that reads the data in the transponder (Weber & Weber 2010, 3.)

Laranjo and Macedo and Santos (2012, 778) also describes RFID as a system where radio signals are conveyed to a particular transponder and to which it replies with another corresponding radio signal. It purposes to convey data in appropriate transponders such as tags and carry it through by means of automatic reading to the right place and at the right time depending on the target application.

The availability of tags creates the requirement to read and analyze them. Components such as antennas and readers help transfer the data to a host computer and added to this is the need for an information system and a corresponding software program to handle the data usage. The main advantage of using RFID is in its ability to read without the need for physical contact. For the purpose of clarity, the RFID tag; not to be mistaken with the more inclusive RFID is defined by Zhou (2013, 73) as “a simplified, low-cost, disposable contactless smartcard”. Therefore, RFID constitutes an integral part of the IoT paradigm because of the tasks it performs. It is in essence very relevant in wearable devices and related technologies.

3.2 Wearable Computing

3.2.1 Wearable Technology

Wearable Technology is increasingly penetrating every aspect of daily lives. Tehrani and Mitchell (2014) defines Wearable Technologies as electronic devices that could be embedded into accessories and clothing items to be worn on the body. Wearable devices have the ability to perform many of the computing tasks that mobile phones and portable personal computers are able to but could in fact in some cases outperform them completely due to some additionally sophisticated features such as biofeedback and physiological tracking. Wearables have the tendency to possess more sophistication than other available mobile technologies today because of the ability to provide sensory and scanning capabilities not typically found in other mobile devices and portable computers. Wearables generally possess some communication abilities which create the possibility to make real time information access.

While the concept of wearables generally refers to technologies that would be worn and removed with ease, it could also refer to more invasive versions such as micro-chips and smart tattoos. Fundamentally, whether a device is worn on the skin or embedded into the body, the impetus for wearable technology is to create a continuous, portable and flexible access to electronics and computers. Examples include wrist watches, eye glasses, contact lenses and smart fabrics. Prior to commercialization, this technology was applied in military technologies and mainly in healthcare and medicine (Tehrani & Mitchell 2014.) Although there is an existential lack of depth in understanding the concept of wearable technology by many, those who are more in tune with latest technology trends are willing to invest in the technology (Statista 2014a.)

3.2.2 Wearables Application Chart

Wearable technologies can be applied to various disciplines and spheres of application. Wearables are forging a closer relationship between humans and technology, with innovative solutions such as computer-assisted watches fitness armbands and data

glasses that are used synchronously with a Smartphone (GFK 2014, 1.) Figure 6 below shows the various fields and scope where wearable technologies could be applied.

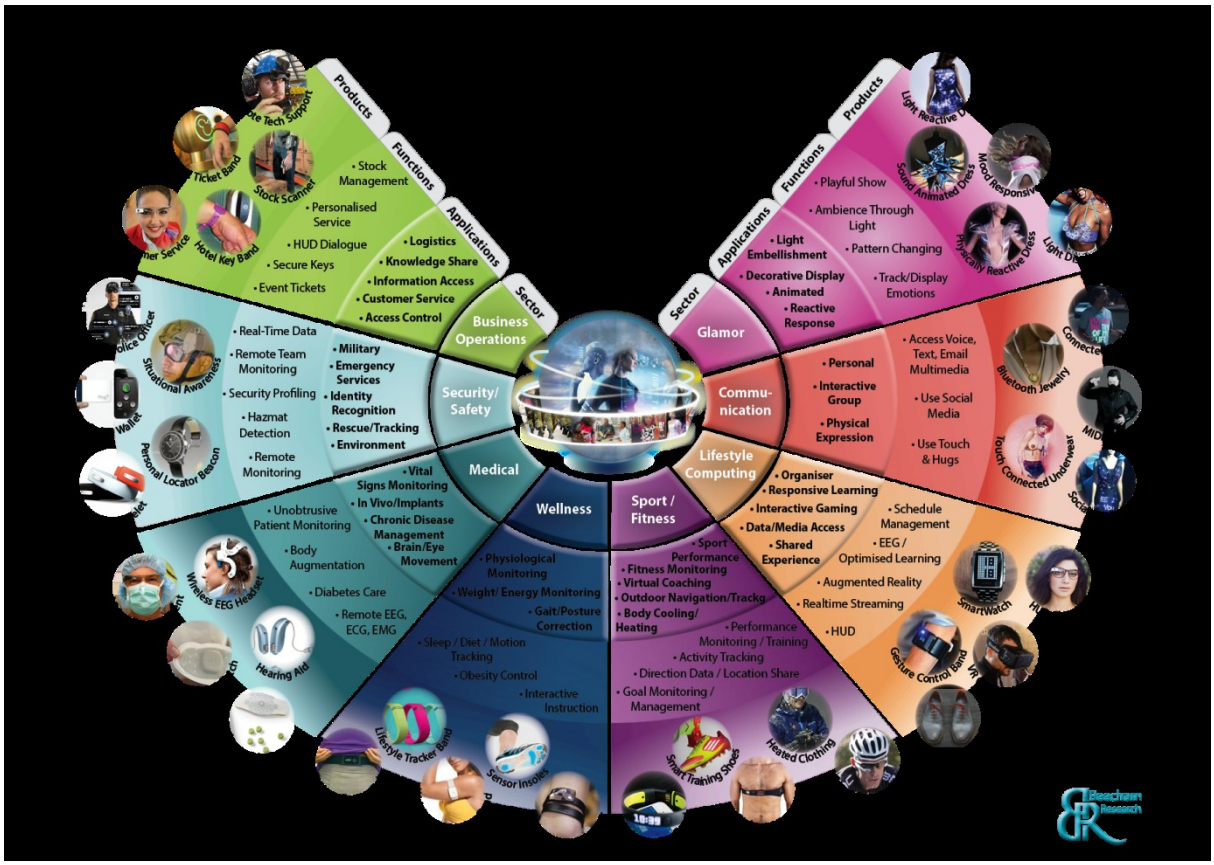


Figure 6. Wearable Technology Application Chart (Beecham Research 2015)

The figure above presents a layered approach to the application scope of wearables. The figure presents the principal sectors where the technology is applied, the applications that are used in that sector, the specific functions that are performed and the products or services that are produced or delivered at the end of the process. It is observed that wearables are applicable in various industries; ranging from fashion to sports/fitness, security, business corporations, telecommunication and Medical/Wellness. The medical, wellness, fitness and sports industries are of particular relevance to the wearable technologies in this research and would be extensively discussed in chapter 4.

Activity and fitness tracking devices have proven very popular with consumers. Based on a survey conducted by GFK (2014, 3) among all application areas of wearables,

sporting activities and health related applications are the most popular in the five countries surveyed. Other activities like temperature and navigation were secondary and all these applications are integrated into a single wearable device such as a Smartwatch.

3.3 Activity Monitoring Sensors

Sensors can be defined as devices which convert physical actions into signals that are interpreted with the aid of an observer or instrument. Sensors range in functionality and size from tiny implantable nanosensors to Magnetic Resonance Imaging (MRI) scanners. However, irrespective of the size and specific area of function every sensor shares certain essential characteristics such as sensitivity, range, accuracy and precision. The sensitivity feature depicts changes in the output of the sensor whenever there are changes in the quantity being measured. The Range indicates the quantity change that the sensor is able to measure from minimum to maximum. Accuracy indicates the degree of closeness of the measured quantity to its real value. Finally, precision measures the extent of difference between multiple repeated measurements. These fundamental properties are relevant for the design, calibration, use and modeling of output data with the intention of monitoring physical activity (Chen & Janz & Zhu & Brychta 2012, 2.)

Sensors are very important for the effective and accurate functioning of activity monitoring devices. Tracking sensors such as Global Positioning Satellite (Hereinafter GPS), and Accelerometers are fundamental components of wearable fitness monitors. These tracking sensors are better discussed in the following sub-sections.

3.3.1 Global Positioning System (GPS) Sensors

GPS sensors serve as receivers that collect and compare radio signals for establishing its location on the Earth. The sensor works by collecting data from several orbital satellites and uses the data to calculate the time it takes for individual signals to arrive at the GPS receiver, after which the GPS sensor is able to establish the location by using the

difference in the reception time. With a location data accuracy of 10 meters radius and an enhanced accuracy of about 2cm when equipped with certain specially designed equipments near the sensor receptors (Theiss & Yen & Ku 2004, 90-91.)

A minimum of four satellites are needed to estimate the location data including the elevation of the receiving sensor. The GPS sensors are able to establish an estimate location using the process of triangulation based on the location data that is being sent from the orbiting satellite. GPS technologies are increasingly being utilized in health related research and for the monitoring of physical activities (Duncan & Badland & Mummery 2008, 550.)

3.3.2 Accelerometer Sensors

Accelerometers sensors are used to measure the extent of motion and in essence the general level of physical activity including an estimate of the quantity of energy spent. There are certain characteristics that make the accelerometer and other similar motion sensors unique; examples are that they come in small packages, simple user interface, long-lasting stability, extended monitoring period, active range, and the freedom of movement in their configurations while measuring physiological variations (Chen et al. 2012, 5.)

Accelerometers are increasingly being used in mobile and portable devices and are also an essential component of wearable devices. The relatively small sizes of micro-electric mechanical systems that are used in movement detection sensors make them the primary choice of system in accelerometers. Other characteristics of these systems include; low energy usage, high sensitivity, cost-effectiveness, and in certain models, the ability to measure gravitational mass (Chen et al. 2012, 5.)

4 MOBILE HEALTH AND FITNESS MONITORING

This chapter presents an overview of wearable mobile health and fitness monitoring. The first section addresses the concept of mobile health. Smart wearable systems are discussed in the second section. The third section looks into the concept of Health 3.0 while the fourth section examines the effect of mobile health and wearable technologies on Big Data. The fifth section discusses the economic impact of wearables and finally the sixth section highlights the privacy, security and reliability concerns associated with wearable fitness monitors.

4.1 The mHealth Concept

Mobile Health can be generally defined as "healthcare to anyone, anytime, and anywhere by removing location and temporal constraints while increasing both the coverage and the quality of healthcare". Mobile health is not limited to the use of health related applications on mobile devices, but also the use of wireless technologies and sensors on mobile devices to access healthcare services; it also enables healthcare workers with decision making especially during emergency situations and the possibility for the elderly to personally manage their daily activities (Varshney 2014, 20.)

Mobile Health provides a platform for the use of advanced applications that could be used for the prevention of diseases, mobile decision making, remote health management, and emergency response. Although, mHealth does not have the capability to solve every health related challenges; the coverage of healthcare delivery can be significantly increased. The decision making process is also improved as a result of the transition from the traditional system where healthcare professionals control the entire decision making process to one where they manage the information provided by the patients using the available mHealth tools. As a result, the patients are also part of the decision making process and there a possibility to acquire highly-personalized treatment (Varshney 2014, 20 & 22.) There are other advantages associated with the

implementation of mHealth, these benefits are highlighted by (Varshney 2014, 23); some of the advantages are listed below.

1) Increase in Healthcare access
2) Improved decision making
3) Faster decision making
4) Improved Accuracy in decision making
5) Prevention of Chronic diseases
6) Efficient management of Chronic diseases
7) Rapid emergency response
8) Swift information access during emergencies (Varshney 2014, 23.)

The list above provides an insight in to some aspects of healthcare delivery where mHealth could be of significant advantage. In order to have an effectively functioning mHealth system, a number of basic technical elements need to be put in place. The Figure below illustrates one of such scenarios.

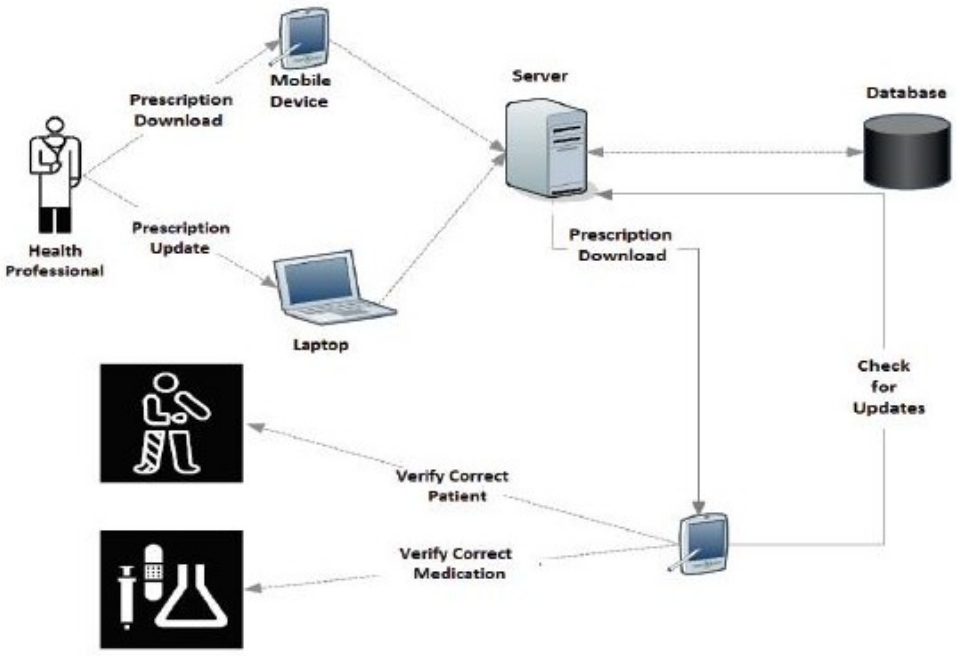


Figure 7. Mobile Health for Medical Prescription (Santos & Macedo & Costa & Nicolau 2014)

Figure 7 above depicts a universal system for applying mHealth in medical prescription. The system provides for mobility and in essence flexibility to all the key players within the systes; inclusing the patients and healthcare professionals. When the healthcare professionals issue prescriptions using their personal mobile or fixed devices, the information database is instantly updated. The patient or patient's caregiver, using their personal mobile or wearable devices with the corresponding medical app are able to immediately receive their prescriptions (Santos et al. 2014.)

4.2 Smart Wearable Systems

Smart wearable Systems (Hereinafter SWS) are an extended concept of wearable technology. These systems are used mainly in healthcare and wellness monitoring but also in other spheres of application. For the purpose of health monitoring, SWS's are used to bridge the interactive gap between the sorroundings and both the physical and mental abilities of persons with illnesses and disabilities. SWS's help to improve performance and decrease the likelyhood of illnesses and diseases. The system provides support for certain groups such as the elderly with focus on those who live alone, post-surgery for patients to speed up the recovery process and for the examination of an individual's sporting activities (Chan & Estève & Fourniols & Escriba & Campo 2012, 137.)

Smart wearable systems may also include embedded or implantable devices. These devices includes, sensors, actuators, smart fabrics, electric supplies, Wireless Communication Networks (WCN's), processing units, multimedia devices, user interfaces and software algorithms for decision support. These systems have a wide range of application that includes the measurement of body temperature, heart rate, blood pressure, Electrocardiograms (ECG's) and the rate of respiration. These measurements are transmitted across a wireless sensor network to either a centralized device like the Personal Digital Assistant (PDA) or an Healthcare center. The healthcare professionals are then able to measure The Table below shows the various vital signs that can be measured using SWS, the types of sensors used and the source of the signal produced (Chan et al. 2012, 137-138.)

Table 1. Smart Wearable Systems for Health Monitoring (Chan et al. 2012, 140)

Type of vital signals	Type of sensor	Signal source
Electromyogram (EMG)	Skin electrodes	Electrical activity of a muscle
Electroencephalogram (EEG)	Scalp-placed electrodes	Electrical activity of brain, Brain potentials
Activity, mobility, fall	Accelerometer	Gesture posture/limb movements
Respiration rate	Piezoelectric/ piezoresistive sensor	Inspiration and expiration per unit time
Heart sounds	Phonograph	Record of heart sounds, with a microphone
Blood glucose	Glucose meter	Assessment of the amount of glucose in blood
Oxygen saturation	Pulse oximeter	Oxy-hemoglobin in blood
Body or skin temperature	Temperature probe or skin patch	Body or skin
Galvanic skin response	Woven metal electrodes	Skin electrical conductivity

Table 1 above depicts the various physiological parameters that can be measured using SWS for health monitoring. The Table also balances these parameters with the particular sensor that is relevant for its functionality and the source from which the transmitted signal is generated. For example; physical activities that involves movement uses Accelerometer sensors and the source of the signal is generated through limb movements through gestures.

4.3 Health 3.0

Health 3.0 is the latest conceptual generation of Electronic Healthcare (Hereinafter eHealth). Health 3.0 is a term that is closely associated with the digital concept of Web 3.0. Health 3.0 is often perceived as a meeting point between social media and healthcare owing to the self management nature of patient related information and the possibility to share it across multiple digital platforms. With Health 3.0, there is a common interactive media that bridges the gap between patients and healthcare professionals. This media, often in the form of a web browser or mobile based application allows for continuous daily support for medication compliance and

healthcare professionals can contact patients irrespective of distance thereby creating a better sense of understanding (Nash 2008.)

Health 3.0 increases the possibility for personalized healthcare. Carrera and Dalton (2013, 38 original emphasis) observes that the driving force behind personalized healthcare owes not only to an increase in technology use but also a demand for more transparency by consumers and patients. Additionally, consumers want better control over health related experience and this situation has lead to an increase in individual medical information sourcing. To fill this void, Health 3.0 will provide a similar but enhanced platform to the existing technologies on wearable fitness monitors. The figure below provides a brief analysis of eHealth generations.

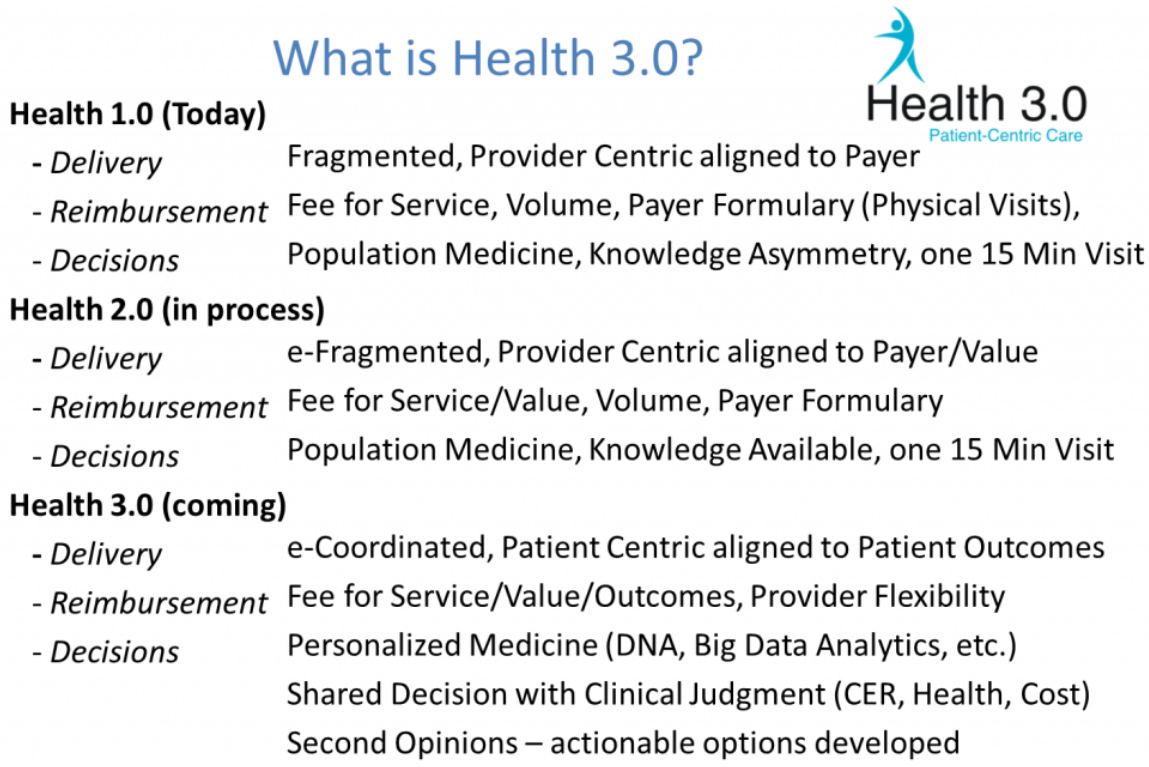


Figure 8 eHealth Generations (Health 3.0, 2013)

Figure 8 above details the three generations of eHealth. Health 1.0 is the more traditional system where decision making is centralized and the methods involve physical availability. With Health 2.0 which is largely employed today, a number of electronic tools are being applied but the decision making lies largely with the service

provider while in Health 3.0 there is a lot more flexibility, services are better personalized and there is a possibility for collective decision making. With wearable fitness monitors, information is updated and accessed using a mobile or web based applications. If the resultant physiological data is managed with the help of a healthcare professional, there is a possibility to better prevent and manage diseases while making significant savings on the cost of healthcare delivery (Health 3.0, 2013.)

4.4 Big Data for mHealth

Big data has become increasingly relevant in mobile healthcare administration. "Big data is a term that describes large volumes of high velocity, complex and variable data that require advanced techniques and technologies to enable the capture, storage, distribution, management, and analysis of the information." (TechAmerica Foundation's Federal Big Data Commission 2012 as cited by Gandomi & Haider 2014, 138). With regards to personalized mHealth, Big Data presents opportunities for further research and the provision of personalized healthcare. Advanced technological platforms like Big Data would help to collect, process, manage and analyze medical data. Additionally, Big Data would help to put the data in the relevant context, it would interpret the data and provide swift and accurate support in the healthcare domain (Horgan & Romão & Torbett & Brand 2014, 226.)

Big data is also being used to enhance the operability of wearables. For example; Wearable bands that are worn on the body combines technological innovations with fitness monitoring in novel ways. This device analysis the collected physiological data and provide an understanding of how the individual's lifestyle affects their health and fitness using Big data analytics. A futuristic application of this technology is that embedded and ingestible wearable devices could help to predict and analyze internal body changes for the prevention of emergencies (Horgan et al. 2014, 227.) the Figure below shows a typical modern wearable wristband from one of the well known brands.

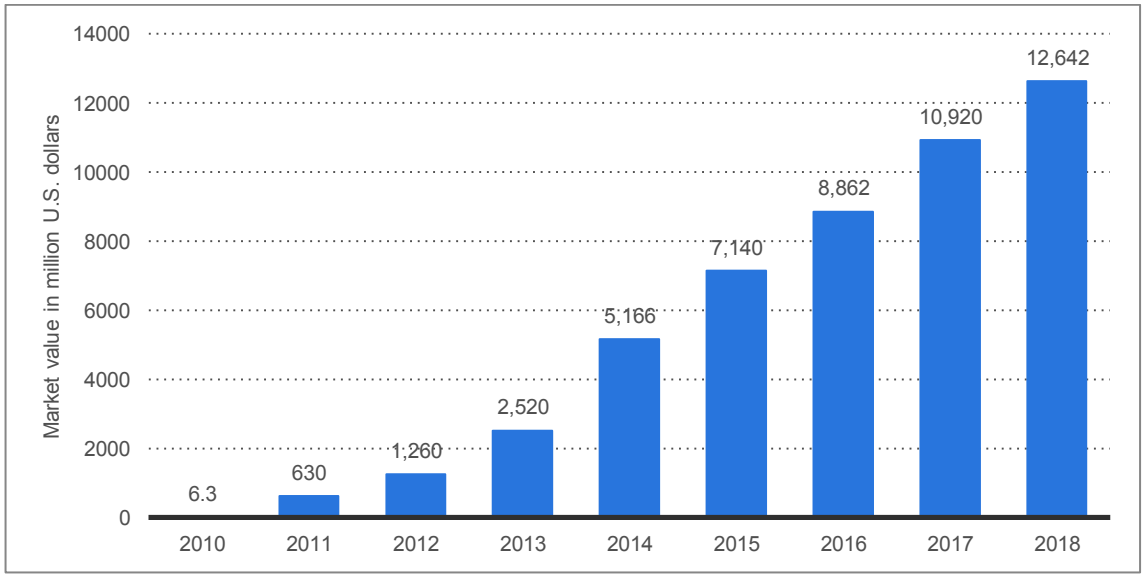
Figure 9. Fitbit Charge HR Activity Monitoring Wristband (Fitbit 2015a)

Figure 9 above pictures a Fitbit wristband for health and fitness monitoring. The Fitbit Charge HR wristbands are designed to monitor vital signs and help the user to design a better disciplined sleeping routine. The specialized feature on this wearable device is the PurePulse heart rate monitor which collects continuous data about the heart rate. Other features include; motion tracking, burnt calories and sleep patterns (Fitbit 2015a.) The acquired data is synchronized with a dedicated mobile application installed on a smart phone. This process paves the way for Big Data Analytics because of the need to store and analyze the ever increasing database of health related information.

4.5 Economic Relevance of Wearables

There is a general positive economic outlook for wearable devices. In 2014, the market valuation for wearable devices in the form of sports, fitness and activity monitors including smart watches is about $3000 million while the general wearables market was worth over $5,000 Million. The market value of wearables is growing at a rapid rate annually and the smartwatch represent the most purchased piece of wearable device. (Statista 2014b; Abramovic 2015.)

The smartwatch provides a multifunctional platform which allows it to serve as a watch, mobile phone; mainly for calls and SMS (Short Messaging Service) functions, activity and fitness monitors and for the measurement of other physiological parameters. However, only about 15 percent of consumers use wearable devices with fitness and health monitoring capabilities and this consumer gap presents a huge market opportunity for manufacturers and marketers alike. The economic potential is significantly increased when these devices are used with the supervision of healthcare professionals. There will be much more flexibility in healthcare management which will also lead to a reduction in general expenditure and cost of managing health (Statista 2014b; Abramovic 2015.) The graph below is a comparison of annual growth in the wearable industry.



Graph 1. Wearable device market value from 2010 to 2018 in million U.S. dollars (Statista 2014b)

Graph 1 above in the form of a chart offers a graphical representation of the market valuation for wearables from the year 2010 to 2018. The graph shows the significant growth that has been achieved in the wearable sector and the economic forecast is very optimistic. The market value for wearables in 2010 was $6.3 Million and by 2018 is estimated to be worth about 12,600 Million (Statista 2014b.) With the wearable health

and fitness monitors, one significant issue of concern for consumers is the relatively high price per unit. In order to maintain a progressive economic atmosphere, prices of the wearables have to be reduced to ensure affordability and wider reach. It is also important to balance the cost and quality of produce with improved reliability and security (mHealthWatch 2014; MEDCITY News 2014.)

4.6 Privacy, Security and Reliability

The increasing interest in wearables has attracted concerns related to security and privacy. Typical of any emerging technology trend are also concerns related to reliability and the ability to deliver as promised. In order to function effectively, wearables have been designed to be intrusive and they collect valuable personal information about individuals. Any security flaw would create an avenue for cyber-criminals to gain access to gain access to sensitive and private information about the victim. Such a situation could be of significant damage to both the individual and organizations which sells the products or delivers the services (Martini 2014, 15.)

Smartwatches are of particular concern. The Smartwatches are able to both store and transfer data. Data storage requires many security procedures to prevent intrusion. There is also a concern about the nature of data being stored and if it violates certain individual rights and organizational policies depending on where the data is being collected. Therefore, it is a matter of priority that adequate security guidelines and applications are provided to prevent unauthorized access (Martini 2014, 15; Santos et al. 2014.)

In the mHealth domain, wireless connectivity is important for the transfer of data. Wireless connectivity is prone to various security challenges because data transmission is made using radio frequencies. Proper security measures must be implemented to prevent data from being destroyed, modified or stolen. The RFID chips as the name implies, are reliant on radio frequencies for data transmission and data is only valuable when its integrity is still intact after transmission (Santos et al. 2014.) Additionally,

Internet wireless technologies and Bluetooth technology are prone to vulnerabilities and it is recommended that the current technologies be further enhanced to improve security.

Weber and Weber (2010, 45 original emphasis) suggests four key system reliability requirements from the more encompassing IoT perspective. These suggestions were made considering the economic value of data, though it is also necessary to consider the human cost if reliability is compromised. Below are the requirements.

1) "Resilience to Attacks: The system has to avoid single points of failure and should adjust itself to node failures.
2) Data Authentication: As a principle, retrieved address and object information must be authenticated.
3) Access Control: Information providers must be able to implement access control on the data provided."
4) User Privacy: Precautions should be put in place to ensure that only the information provider is able to make conclusions based on the observations made while using the lookup system on a particular user. It should at least be difficult to collect information from the system.

5 WEARABLES ADOPTION PROPOSITION FOR NATURKOMPANIET AB

This chapter presents the recommendations made for Naturkompaniet AB. The recommendations are for the adoption of wearable health and fitness monitors to enhance comfort and safety for their customers while increasing the profit margin and competitive advantage. This chapter makes analysis based on the interview conducted with some members of staff in the company's Haaparanda, Sweden Outlet. The chapter also consists of recommendations on how to channel the products towards their target market while collaborating with healthcare institutions and providers. The first section discusses the relevance of wearable fitness monitors to outdoor activities. The second section presents ways to adopt wearable fitness monitors into the product line. The third section finally addresses the possible challenges if the recommendations are considered.

5.1 Relevance of Wearable Fitness Monitors in Outdoor Activities

It is the wish of every organization to make a lasting impression on their customers. However, in the post-recession era it is important for organizations to strike a balance between good customer satisfaction and increased revenue generation. Customer satisfaction is a measure of how well a customer's expectations about a product or service rendered by an organization have been met (Education Portal 2015). For a company like Naturkompaniet AB to survive in an increasingly competitive global economic environment, it is necessary to adopt innovative concepts and products that are geared towards their customers. Naturkompaniet AB specializes in wares for outdoor events like camping and sport related activities, wearable fitness monitors offers the possibility to both improve customer satisfaction and increase their revenue.

The members of staff were interviewed and their opinions were sought concerning the relevance of wearable fitness monitors. There was a collective agreement concerning the importance of wearables particularly among the customers who value fitness. Some weeks after the interview was conducted, one of the interviewees sent a message to inform me that Sweden's most popular Christmas gift for the year 2014 was wearable fitness bands. This development was buttressed in the research conducted by HUI

(2014) which attributes the situation to an increased awareness by individuals regarding health, fitness, physical activities and wellbeing.

The Store Manager's perception of wearable fitness monitors is that of a slightly futuristic technology. However, many organizations are starting to key into the rapid popularity wearables have enjoyed particularly the fitness monitors. These devices are being sold on online shops and in conventional store outlets and are increasingly popular among fitness enthusiasts. The trendy and sleek design also gives consumers the possibility to make a fashion statement with the devices; this could make the devices even more popular within the youthful age range.

The Sales Personnel gives a more optimistic view of wearable fitness monitors. She sees it as a wise decision for any organization to adopt these devices to their line of products as the popularity increases. With the popularity comes more competition and the competition should lead to more competitive prices. This is a very important issue because the average prices for the devices particularly among the more established brands could be reduced.

5.2 Introducing Wearables into the Product-Line

The next consideration to make after identifying the relevance of wearables is that of implementation. The store manager is of the opinion that adding wearable fitness monitors to their line of product would increase their customer base and add more value to the services. In this situation, the wearable of choice should be of significant value and relevance to the already existing products and services being delivered by the company. This is not to suggest that Naturkompaniet AB create a manufacturing department or production line for wearables. However, a partnership with one of the more established and tested brands would be a preferred option.

One suggested brand is the Fitbit range of bands. With this brand, there is a multiple range of options for consumers to choose from. Fitbit monitors offer the possibility to either buy a device and wirelessly synchronize it with a dedicated mobile application or

download the mobile application alone and use the Smartphone's GPS to monitor parameters like pace, time and distance even without the Fitbit device. Fitbit offers devices that can monitor single physiological parameters but in most cases multiple parameters and one such device is the Fitbit Surge Fitness Power Watch.

The Fitbit Surge Fitness Power Watch offers a form of GPS tracking that records distance, pace of movement, reviews the routes followed, observe split timings and the elevation attained. The PurePulse heart rate feature continuously monitors the heart rate using the pulse from the wrist. The smartwatch also monitors every daily activity and movements such as steps taken, distance covered, floors climbed, burnt calories and all the active minutes of the day. For active sports persons, there is a function that takes record of running, cross training, cardiovascular workouts and logs in a summary of every workout activities. This device can be synchronized automatically using wireless technology (Fitbit 2015b.)

The physiological parameters measured by this device are well suited for outdoor activities. The clients of Naturkompaniet AB are mainly physically active individuals and those who are interested in camping or hiking. The ability to monitor the heart rate during physical activities would be a welcome development particularly for those who are hypertensive or with cardiovascular related health issues. There is also the possibility to choose other products that best suits an individual's lifestyle and health conditions depending on the available features.

5.3 Challenges Presented by Recommendations

There are certain challenges that are typically associated with emerging technologies. In section 4.6, concerns about privacy, security and reliability were discussed. In addition to those concerns, one possible challenge is that of locating a suitable market. This concern was voiced during the interview with the store manager who was concerned about finding the right customers to for the new products if sale of the devices are adopted. This is an important factor to consider because there is no value in selling a product or rendering a service if an organization is unable to establish a market. A possible solution perhaps is offered by Quinn and Faerman and Thompson and McGrath

and St. Clair (2011, 272) that a promotional message needs to be expressed from the managerial level. Promotional messages are used to promote actions and new decisions. The messages are persuasive and employ action words and example scenarios with the primary goal of reaching a decisive end.

The Manager and Sales Personnel both agree that reliability is an issue of concern. If the wearables are not able to deliver as promised, for example; if the blood glucose or heartbeat pulse measurements malfunctions regularly, it has the tendency to cause panic and may lead to wrong diagnosis. This could be detrimental to the health of the individual. Another example is that most wearable fitness monitors are not able to operate in temperatures below -4 Centigrade. Additionally, wireless networks are not always available especially in remote areas and the devices might not function as intended. These concerns about reliability are ones that should be critically examined by stakeholders.

Security is always a matter of concern with computer devices. With wearable fitness monitors, devices are more intrusive and tend to gather, store and transfer personal information. The sensitivity of the information calls for an adequate security framework to deal with the challenge. One possibility is for the manufacturers of the fitness bands to collectively agree on an industry wide security standard for wearable fitness monitors.

6 CONCLUSIONS

In a continuously mobile driven information society where devices and gadgets continue to shrink in size price, efforts are being made continually by stakeholders to bring the computer much closer to humans. Hence the concept of Wearable Technology, one that has is increasingly popular and being integrated into various spheres of life. Despite this trend, a lot still needs to be done to inform prospective consumers and stakeholders on the technology and allay any fears they might have concerning the use and investment in wearables. Therefore, the general aim of this research was to explore the concept of wearable technology and mobile health and in the process provide a comprehensible knowledge of the concepts of wearables. A case was made for a broader scale integration of wearable health and fitness monitors into mobile healthcare service provisioning. This argument was made considering the feasibility of this idea and the economic implications. References were made to statistics from research organizations to buttress this argument. The practical outcome of this research was achieved by proposing recommendations for Naturkompaniet AB.

There are many challenges facing the adoption of wearable technology. These challenges are often two faced because both consumers and organizations have raised questions. Consumers worry about privacy and the security of their personal information considering the invasive nature of wearables. Certain consumers also worry about the reliability of wearables some of which boasts of relatively unique features that are yet untested on a wider scale (Sarkkinen 2014,). Organizations alike have to contend with issues of legislation from a global and localized perspective because different countries have their own specific laws governing the use of these devices and more is being expected from governing bodies and regulatory agencies like the International Corporation of Assisted Names and Numbers (ICANN) (Weber & Weber 2010, 71). It is obvious that more has to be done by the relevant international governing authorities to enhance the protection of consumers. Evidently, there is also a long way to go as far as providing an understanding of wearables to the target market.

Wearables are being integrated into a number of application spheres, but the scope of this thesis work is limited to its integration into healthcare with emphasis on health and

fitness monitors. Even though wearable fitness monitors are a relatively new technology, it has evolved and matured rapidly and the future forecast is very encouraging to say the least. However, many of the devices are being utilized by consumers alone without the oversight of healthcare professionals. Therefore, there is the need for an integration of wearables into mHealth for more effective health monitoring, cheaper healthcare service provisioning and in essence an economic viable alternative. Wearables are already playing a major role in daily lives and as far as mobile health is concerned, there are lots of possibilities to be explored.

The study of wearable technology is of strategic significance to the field of IT, wearables possess significant flexibility evidence in the possibility to adapt it into various disciplines. However, there is a need to conduct further research into wearables. Future research into wearables should explore and address the privacy and security challenges because these are real concerns that are typically associated with evolving IT technologies. Research into this aspect is important in the case of wearables where the technology is naturally intrusive as observed by Weber and Weber (2010, 44).

Drawing on this research, it is observed that Naturkompaniet AB and their clients could benefit significantly from the adoption of wearable devices to their product line. Furthermore, such addition is made possible by the fact that wearable devices cut across ages because there is a device suited for every age group. The primary products and services of the company also consist of outdoor recreational wears with emphasis on the Polar Regions. Hence, wearables are very well suited for their client base. Adequate consultations need to be made before embarking on the adoption process and it is also recommended that partnership be made with reputable wearables manufacturers.

Wearable Technologies are gradually becoming a part of consumer's daily lives to stay. An increasing number of organizations are also starting to realize the importance of wearable fitness monitors. The available statistics pertaining to wearable fitness monitors all have a very positive outlook for the next half decade and beyond. The most preferred wearable devices are the ones with the ability to monitor health related activities. The strength of wearables lies in the health and fitness monitors and its

integration into mHealth services. The combination of these two disciplines will be of significant influence to improving healthcare service provisioning.

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APPENDIX 1

Interview #1

Monica Sarkkinen, Store Manager (Naturkompaniet AB, Haaparanda Outlet)

Q: Are you familiar with the Internet of Things and wearable technology concept?

A: No, I am not familiar with the concept.

Q: If yes, what are the things you know?

A: -

Q: What do you think about the individuals that are already using these devices?

A: I think the devices are for those who are more familiar with technical gadgets.

Q: What do you think about the organizations that are investing in these devices? Is it a wise decision?

A: Yes, it is a good idea. I think wearable devices are suitable for people who like outdoor activities. The ability to measure blood pressure is good but I am not sure about the accuracy of measuring blood glucose without taking a person's blood sample.

Q: How popular do you think the devices are and will be in the near future?

A: I think the devices are still futuristic, but as time goes on it will increase in popularity.

Q: How important do you think the wearable devices will be in future in general and as far as health and fitness tracking is concerned?

A: It is an easy and portable way to manage your health especially when you travel.

Q: Does your organization have any health monitoring wearable devices in her product line?

A: No, we do not have in our outlet but maybe it is available in other outlets.

Q: If not, does our organization have any plans towards the use of wearable devices?

A: I am not sure about that.

Q: Are there any advantages or potential benefits that could arise as a result of investment in wearable devices, in your opinion?

A: Yes, it could help to attract some other group of customers.

Q: What do you think are the possible challenges that could arise as a result of investment in wearable devices, in your opinion?

A: It could be a challenge to find the type of customers that are interested in this product.

Q: Do you think that organizations should invest more in wearable devices? And why?

A: Yes. At Naturkompaniet AB, we specialize in outdoor wares and wearable devices can add more value to our company.

Q: Would you suggest that these wearable devices be used more with the supervision of qualified medical personnel?

A: Yes, it is a good idea.

Q: Do you have any fears or concerns about the use of wearable devices for health monitoring?

A: Yes.

Q: If yes, what are the possible concerns?

A: I cannot trust the devices if they have not been well tested. It can place people in danger or lead to death if the blood pressure values does not show correctly.

Q: Are there any additional information?

A: No, nothing I can think of now.

Appendix 1

2(2)

Interview #2

Charlotta Olsson, Sales Personnel (Naturkompaniet AB, Haaparanda Outlet)

Q: Are you familiar with the Internet of Things and wearable technology concept?

A: Not as familiar as I wish to be. Unfortunately, all of these devices are not yet very popular here. Although, Nike Fuelbands, Pebbles watches and such have been found in stores here for some years.

Q: If yes, what are the things you know?

A: Nike Fuealbands and Pebbles watch

Q: What do you think about the individuals that are already using these devices?

A: I think the individuals using these devices are young and active people.

Q: What do you think about the organizations that are investing in these devices? Is it a wise decision?

A: Of course, it is a wise decision for the right company. The more popular these products get, the wiser it is to invest in them.

Q: How popular do you think the devices are and will be in the near future?

A: I think the popularity will increase. Partly because the prices are getting more realistic, but also because being active and having an active life is getting more and more popular. People simply want to move and keep track of how much they are doing. The younger generations are also making use technological devices for loads of different things.

Q: How important do you think the wearable devices will be in future in general and as far as health and fitness tracking is concerned?

A: Today people must themselves be very active in terms of healthcare. Nowadays, prescriptions are not written only on drugs, but also on exercise devices which leads to the fact that these devices will also be needed by most people.

Q: Does your organization have any health monitoring wearable devices in her product line?

A: No.

Q: If not, does our organization have any plans towards the use of wearable devices?

A: Not that I know of

Q: Are there any advantages or potential benefits that could arise as a result of investment in wearable devices, in your opinion?

A: An advantage in investing in wearable devices right now would be, at least in my tiny home town you cannot yet find them in many stores.

Q: What do you think are the possible challenges that could arise as a result of investment in wearable devices, in your opinion?

A: The challenge could be to get people to dare to try, especially the older generations.

Q: Do you think that organizations should invest more in wearable devices? And why?

A: Yes. The more these devices get portable and available, people will get used to them. Even the older generations.

Q: Would you suggest that these wearable devices be used more with the supervision of qualified medical personnel?

A: Yes.

Q: Do you have any fears or concerns about the use of wearable devices for health monitoring?

A: Yes.

Q: If yes, what are the possible concerns?

A: Concerns about how reliable they really are. If they don't show right (ex. blood glucose) people might not search for help even if they should need it.

Q: Are there any additional information?

A: No.